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A comparative evaluation of guttapercha removal by various rotary files: An *In vitro* study

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Abstract

Aim: To compare the efficacy of different rotary instruments for removing obturating material from root canals.

Materials and Methods: Thirty extracted human premolar teeth having a single canal were selected. The biomechanical preparation of the root canals was done with Protaper rotary file and obturation was done with corresponding guttapercha cone. The samples were divided into three groups according to the rotary file used for removing the obturating material: Group I – Protaper D; Group II – Hyflex EDM; Group III – NeoEndo. The amount of remaining filling material after the retreatment procedure was checked under stereomicroscope. The data was statistically analysed by one way Anova test.

Results: Group I (Protaper D) left less remaining filling material compared with group II (Hyflex) and Group III (NeoEndo)

Conclusion: The Protaper D was most effective in removing the gutta-percha from the root canal. Keywords: Hyflex EDM, Protaper D, Neo Endo retreatment files.

Keywords: atomic force microscopy, Ni-Cr alloys, Profilometer, Shear bond strength, Sandblasting

Introduction

To retain the tooth in proper form and function endodontic therapy is the principle objective. But in few cases, patients may report with failure. In such cases, retreatment is the treatment of choice [1]. For the proper cleaning and reobturation complete removal of the root canal content and access to the apical foramen in a retreatment are mandatory [2]. Gutta-percha and endodontic sealer are widely used as filling materials, and their effective removal in endodontic retreatment is considered essential for success [3].

Many techniques have been employed for the removal of gutta-percha (GP) in root-filled teeth. These include endodontic hand files combined with heat or chemical solvents, engine-driven rotary files, ultrasonic instruments, heat-carrying instruments and lasers. ProTaper™ (Dentsply Maillefer, Ballaigues, Switzerland) system exhibits progressively variable tapers of each instrument that develop a "progressive preparation" in both the vertical and horizontal directions. The ProTaper™ cross-sectional design mimics that of a reamer, with three machined cutting edges and convex core [5].

Hyflex EDM nickel-titanium (NiTi) Files (Coltene-Whaledent, Allstetten, Switzerland) is produced using an innovative manufacturing process called Electric Discharge Machining. The EDM process results in a file that is extremely flexible and fracture resistant. Neoendo Rotary File System is a combination of strength, Flexibility & cost effectiveness. Offers 300% more cyclic resistance The purpose of this study was to evaluate and analyse the efficacy of Pro Taper retreatment files, Hy flex EDM and Neo Endo files for removal of gutta-percha during retreatment.

2. Material and Methods

Thirty extracted single-rooted human premolars were selected and stored in a 0.1% thymol (Figure 1). Access cavity preparation was done and working length was determined by inserting a size 10 K file (Dentsply/Maillefer) into the root canal until it was visible at the apical foramen and subtracting 1mm from that length (Figure 2). Root canal preparation was done using Pro Taper universal rotary files (DentsplyMaillefer, Switzerland) as per manufacturer's instructions. All canals were prepared upto F3ProTaper file. 2.5% NaOCl (Avorice, India) was used for irrigation after each instrument. The obturation of root canals was done with ProTaper gutta-percha cones (Dentsply/Maillefer) with AH plus (Dentsply De Trey, Konstanz, Germany) root canal sealer. The teeth were temporarily restored with Cavit-G (3M Espe, Germany), and stored under 100% humidity at 37 °C. The adequacy of root fillings was confirmed by radiographic examination in buccolingual and mesiodistal direction. Teeth were randomly divided into two experimental groups.

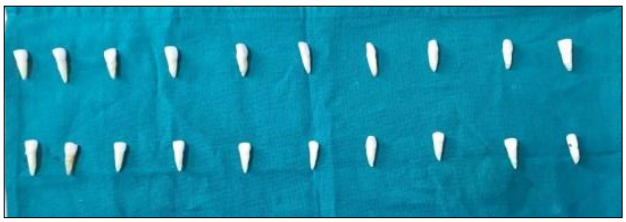

Fig 1: Freshly extracted tooth Samples

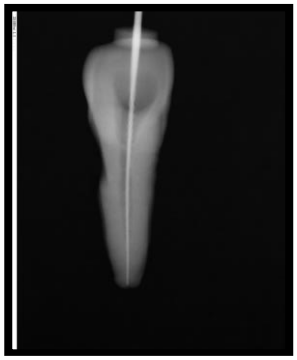

Fig 2: Working Length Determination

Group 1

NeoEndo rotary file utilizes a proprietary heat treatment. It is a tough file with unique flexibility and the flutes do not open up when stress levels are reached and yet, doesn't present shape memory. It has a Cross Section of Triangular with sharp cutting edges and Non-cutting Safety Tip. It is used with a Speed of 350 RPM and a Torque of 1.5 Ncm. It is started by using a #15 size hand file with 2% taper, and the orifice opener rotary file
Narrow Canals – #20 size flex file with 4% taper followed by #25 size flex file with 4% taper Medium Canals – #30 size flex file with 4% taper Wide Canals – #25 size flex file with 6% taper and #35 size flex file with 4% taper.

Group 2

ProTaper Universal retreatment instruments were used to remove the filling material. D1, D2, and D3 were used sequentially applying a crown-down technique until the working length was reached. The instruments were used with an electric motor (X-Smart; DentsplyMaillefer) at a constant speed of 500 rpm for D1, D2, and D3, with a torque of 3 Ncm.

Group 3

Hyflex EDM rotary file was used to remove the gutta percha. Hyflex EDM instruments were used according to manufacturer's recommendations i.e., 10/. 05, 25/. 12, 25, 25/. 12, 40/.04.
In order to standardize the procedure, each file was discarded after being used five times. Gutta percha removal was considered completed when no filling debris was observed either on the instrument flutes or in the irrigating solution. The smoothness of canal walls was checked by tactile sensitivity using the last instrument. To eliminate inter operator variability, the same operator carried out all intracanal procedures. Assessment of effective gutta-percha removal was done by calculating the obturating material remnants in each tooth at coronal, middle and apical third of the root canal. The percentage area of residual filling material at cross sections within the canals was analyzed using the On Demand 3D App software

3. Results

Remnants of filling material were found in all samples regardless of the groups examined. The data was statistically analysed using SPSS version 18.0 software and tested using One Way ANOVA test followed by Bonferroni correction. A p value of 0.05 was considered to be statistically significant. These results demonstrated that group I (Protaper D) left significantly less remaining material compared with group II (Hyflex EDM) and group III (NeoEndo) (Figure 3). Maximum amount of remaining filling material was seen with NeoEndo rotary file which was also statistically significant. Maximum amount of Gutta-percha was found at coronal third and least in apical third of the root canal in all the groups.

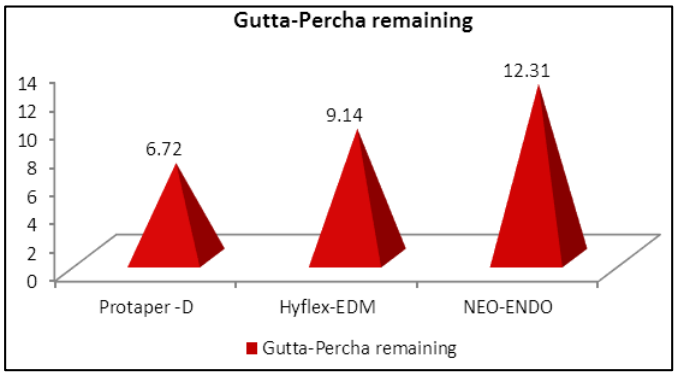

Fig 3: Graphical representation evaluationg remaining Gutta-percha

4. Discussion

Endodontic retreatment is a procedure performed on a tooth that had received prior attempted definitive treatment resulting in a condition requiring further endodontic treatment to achieve a successful result. The main success of endodontic retreatment relies on the complete removal of root canal filling material in order to regain access to the apical foramen so that it facilitates the sufficient cleaning and shaping of entire root canal system.[2] Endodontic failure occurs even when the highest standard and the most meticulous treatment procedure is adhered. When conventional root canal treatment fails, endodontic retreatment is the preferred option as it is one of the most conservative methods. Obturating material in failed endodontic cases and necrotic tissue & bacteria, covered by obturating material, may be responsible for periapical inflammation. As much as possible, the obturating material must be removed to reduce the number of microorganisms within the canal [4]. Insufficient removal of filling material impairs the removal of necrotic tissue or remnant bacteria in the root canal which leads to a failure. In recent years, the use of nickel-titanium (NiTi) rotary files and automated root canal devices has been increasing in endodontic treatments. The advantages of rotary NiTi instruments over hand instruments include facilitating canal preparation, preserving the shape of curved canals and producing smooth surfaces in lesser time than with manual instruments [5]. The single use of endodontic instruments was recently recommended to decrease instrument fatigue and possible cross contamination, cost effectiveness and reducing the number of NiTi rotary instruments required for canal

preparation [6]. The present study compared these new techniques with the ultimate aim of establishing whether they are able to remove filling material from root canals more effectively than other methods.

Anterior teeth were selected because in these, root canals were usually straight so there were less chances of variations in result while analyzing the efficacy of different rotary technique in removing gutta-percha. In this study, none of the three techniques completely removed the filling material from the canal walls in any of the samples. This finding agrees with several previous studies [7]. The results revealed that the Protaper D instrument (group I) was most effective in removing guttapercha. The better performance of Protaper D instrument may be attributed to their design. The NeoEndo rotary files (group III) was significantly least effective in removing gutta-percha. Maximum amount of gutta-percha was found at coronal third and least in apical third of the root canal in all the groups. This might be explained due to more amount of Gutta- percha in the coronal third the taper of the rotary files used to remove gutta–percha. Further research is required to compare the amount of remaining filling material at different levels of root canal using other instrumentation systems.

5. Conclusion

Within the parameters of this in vitro study it can be concluded that among all instrumentation techniques used for the removal of filled material in endodontic retreatment, none of the technique was 100% effective in removing the filling materials, but the Protaper D retreatment file was maximum efficient in comparison to other groups.

6. References

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